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HPC COMPANY DOCUMENT

ENVIRONMENTAL PERMIT APPLICATION: HINKLEY POINT CONSTRUCTION WATER DISCHARGE ACTIVITY VARIATION 13

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APPROVAL: ENVIRONMENTAL PERMIT APPLICATION: HINKLEY POINT CONSTRUCTION WATER DISCHARGE ACTIVITY VARIATION 13

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DOCUMENT CONTROL

Revision	Purpose	Amendment	By	Date
01	P1 – For Implementation	First Issue, following update from pre-application review.	Evie White Richard Mitchener	21/07/2025
02	P1 – For Implementation	Amended following TC review. Footers updated.	Evie White	29/07/2025
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NON-TECHNICAL SUMMARY

NNB Generation Company (HPC) Limited (NNB HPC) is building a new nuclear power station on the northern coast of Somerset.

To allow the delivery of the construction programme, the Construction Water Discharge Activity (CWDA) permit (EPR/JP3122GM) was obtained in February 2012 to permit the discharge offsite of a series of effluents. This Permit has since then been varied 11 times to reflect changes to the composition of the permitted effluents or changes to the site activities, which have prompted the need to add/remove permitted activities to/from the Permit. At the time of writing this report, Variation 12 of the Permit is undergoing determination by the Environment Agency.

CWDA V012 was submitted to add Total Copper, Total Zinc and Free Chlorine as discharge parameters to the trade effluent associated with Activity I (trade effluent consisting of effluent from Cold Commissioning Activities, which includes flushing, hydro-testing and demineralised water production), after assessment of the potential impact of the discharge of demineralised water plant effluent (on the receiving waters. It also recognises that copper and free chlorine may be present within the effluent from the commissioning effluent treatment plant (CETP) as these substances are used within the treatment process.

Activity I was incorporated into the Permit as part of Variation 10 in March 2022. Based on the usage profile for the demineralised water, the intention at the time of the application was to utilise a series of permanent tanks (HXA tanks) to act as a buffer for the demineralised water containing hydrazine and ammonia to maintain an adequate flow rate into the Commissioning Effluent Treatment Plant (CETP), which was designed according to this plan. However, recent reviews of the construction programme have made it apparent that the HXA tanks may no longer be available as planned, which has required NNB HPC to review how the flows of used demineralised water containing hydrazine and ammonia

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associated with commissioning activities will be managed on site and where further discharge capacity is required. Due to this, several changes are proposed:

1. Ammoniated firewater from the site fire hydrant network

Testing of the fire hydrants will be required on a regular basis to ensure that they operate appropriately in the event of fire on site. A small volume of water will be released as individual hydrants are tested (it will not be feasible to contain it) and will enter the site surface drainage network, where it will experience significant dilution within Water Management Zones 1, 2 or 3, ultimately being discharged through under Activity A via Outlet 1 (via Water Management Zones 1, 2 and 3). Discharge from these water management zones is rainfall dependent with discharge pumps being activated when water levels reach pre-set thresholds. Based on conversations with the on-site Fire and Rescue service, it estimated volume of 10 m^3 is expected to enter the surface drainage networks during testing of the hydrants. The worst-case scenario (e.g. lowest possible volume in Water Management Zones 1, 2 or 3) has been considered to estimate the expected concentration of ammonia and ethanolamine in the final effluent. These substances are present in the fire-fighting water to prevent corrosion of the pipework over the life of the power station; the firefighting system is fed by demineralised water and without the addition of these substances could cause corrosion of the steel pipework. As this discharge is rainfall dependent discharge, the dilution considered in the assessment can be considered a worst case.

2. Addition of an Activity J to the existing permit which will allow the discharge of the low-risk effluents generated as part of cold commissioning activities, including:

    a. flushing and hydrotesting wastes, specifically the commissioning effluents not containing hydrazine and ammonia but potentially containing ethanolamine and trisodium

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phosphate[1] at concentrations below those previously assessed as part of Variation 10 (Activity J(i)); and

b. the effluent from the site demineralised water plant (Activity J(ii)).

3. Change of the discharge pattern from a pulsed discharge to a continuous discharge for Activities I and J.

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[1] Ethanolamine and trisodium phosphate may be added to demineralised water to manage the pH and prevent corrosion of systems within the station.

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1 INTRODUCTION

NNB Generation Company (HPC) Limited (referred to as NNB HPC) is developing the first of a new generation of nuclear power stations on the north Somerset coast, approximately 13km northwest of Bridgwater. Under construction arrangements, treated effluent from site is discharged into the Bristol Channel under the Construction Water Discharge Activity (CWDA) Permit. Activity I was added in March 2022 to allow for the discharge of treated effluent from the Cold Flush Testing Phase of Plant Commissioning (also referred to as Cold Functional Testing (CFT)) (See Appendix A for what is currently included under Activity I).

Due to certain changes in the potential effluent storage capacity on site and with the aim of being able to manage the volume of waste effluent generated on site, NNB HPC proposes to amend the site arrangements and permitted activities, as detailed within this document.

1.1 Purpose

The variation application, for which this report provides supporting information, seeks to make a number of changes to the discharge activities authorised under environmental permit EPR/JP3122GM. These changes include:

- Addition of Activity J to the permit, which will comprise the discharge of the environmentally insignificant effluents associated with cold commissioning activities, such as those not containing ammonia and/or hydrazine. Activity J would be subject to MCERTS flow monitoring.
- Change to a continuous discharge from the originally planned pulsed discharge for Activity I and J; this change is required to increase the operational flexibility on site and efficiently utilise the CETP following detailed design. The original pulsed discharge was based on the then proposed operation of the CETP in batch-mode and discharge was not in any way linked to tidal state.
- Amendment to the description of activity for Activity A to include discharge ammoniated firewater leaked during the fire hydrant pressure and flow testing via the construction surface water network.

Note that within Variation 11, activity I included the following effluent streams:

- Waste water from the demineralisation plant (also known as demin reject water) this comprises concentrate from the demineralisation of potable water and the chemicals used in this plant; this water was never intended to through the CETP.
- Demineralised water (with or without chemical additives) that has been used for hydrotesting and flushing. Only some of this effluent actually needs to be treated by the CETP but was planned to pass though the plant.

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To maximise the efficiency of the plant and ensure that treatment chemicals are only used when necessary, it is proposed that only water that actually requires treatment is passed through the CETP. This is water containing hydrazine and/or ammonia. Un-augmented demineralised water and water containing ethanolamine and/or trisodium phosphate, but no ammonia and/or hydrazine will follow the same route as demineralised plant wastewater i.e. will bypass the treatment plant. This combined stream will be covered by the new Activity J with Activity I only covering the effluent that needs treatment.

1.2 Scope

This application relates only to the construction phase of the project and only seeks to incorporate the changes listed in Section 1.1 associated with the discharge of trade effluent consisting of effluent from cold commissioning activities and testing of safety systems (e.g. firefighting). There is no impact on any limits set under the Operational Water Discharge Activity (OWDA).

1.3 Summarised description of the proposed variation

NNB HPC is requesting:

- Permission to allow small quantities (up to $10m^3$) of ammoniated firewater to enter the surface drainage network to allow for the testing of fire hydrants on site.
- The addition of Activities J(i) and J(ii) and to the permit, consisting of the discharge of environmentally insignificant effluents associated with cold commissioning activities. This activity will specifically include:
  - Activity J(i) Wastewater effluent associated with the flushing and hydrotesting of systems not containing hydrazine or ammonia at a rate of up to 1,500 m^3/day.
  - Activity J(ii) Wastewater effluent (concentrated potable water and chemicals used within the demineralised water plant) from the production of demineralised water at a rate of up to 1,500 m^3/day.
- Change of the discharge pattern from a pulsed discharge to a continuous discharge for activities I and J.

The concentrations of key potential pollutants in the Activity I and J effluents and the assessment of impact on the receiving waters have been provided in previous variations (e.g. V010 and V012) of this permit. Variation application V012 is currently under determination by the Environment Agency. This variation application (V013) only intends to segregate these low-risk effluents from Activity I to ensure that the whole capacity of the discharge through Activity I is utilised for the effluent containing

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hydrazine and ammonia, which will be treated at the site Commissioning Effluent Treatment Plant (CETP) prior to its discharge through Outlet 12. This discharge is already authorised under the current permit.

The report includes the following sections:

- Section 2 sets out the proposed variation, including the purpose and requested concentration changes for each substance.
- Section 3 shows the surface water pollution risk assessment which was conducted for each activity, along with justifications and treatment options; and
- Section 4 summarises the conclusions.

1.4 Definitions

Abbreviation	Definition
AA	Annual Average
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CETP	Commissioning Effluent Treatment Plant
CFT	Cold Functional Testing
CIP	Cleaning In Place
CWDA	Construction Water Discharge Activity (Permit)
DPNBA	2-2 dibromo-3-nitrilopropionamide (biocide)
ECHA	European Chemicals Agency
EQS	Environmental Quality Standard
ETA	Ethanolamine
EVF	Effective Volume Flux
GETM	General Estuarine Transport Model
HA	Hectares
HAJ	Construction Sewage Treatment Plant
HPC	Hinkley Point C
MAC	Maximum Allowable Concentration
NNB HPC	NNB Generation Company (HPC) Limited
OWDA	Operational Water Discharge Activity (Permit)
PNEC	Predicted No Effect Concentration
TRO	Total Residual Oxidant
WMZ	Water Management Zone

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2 PROPOSED VARIATION

2.1 Description of current operations

The currently permitted activities that are affected by this permit variation are Activity A and Activity I. Activity A refers to the discharge of trade effluent consisting of site drainage via Outlet 1, whereas Activity I refers to the discharge of trade effluent consisting of effluent from cold commissioning activities via Outlet 12. The approximate location of these outlets is shown in Figure 1 below. Cold functional testing (CFT) refers to the flushing and hydrotesting of systems, which aims to demonstrate the physical integrity of the infrastructure and the circuits.

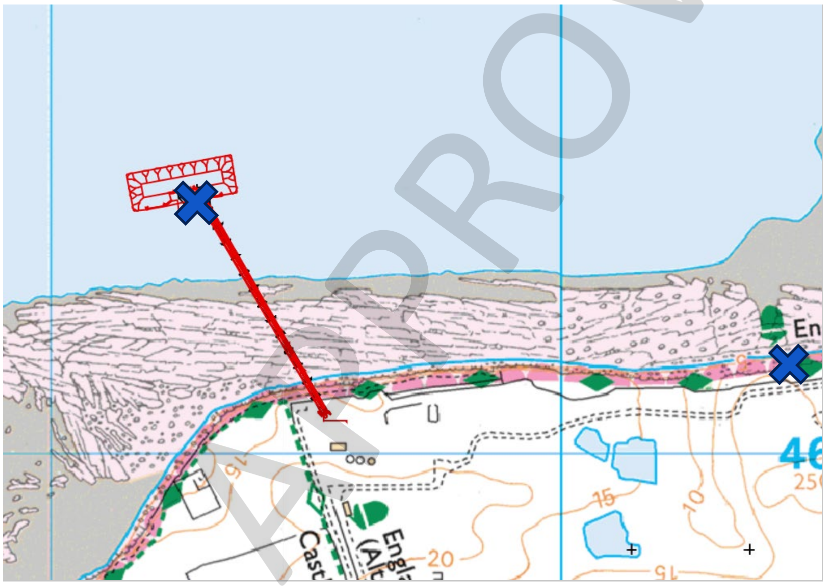

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Figure 1 Location of temporary jetty, Outlet 12 and Outlet 1. The blue Xs mark the approximate location of Outlet 12 and Outlet 1.

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2.2 Effluent Characterisation

2.2.1 Activity A

Activity A refers to the discharge of trade effluent consisting of site drainage via Outlet 1. Activity A currently consists of trade effluent from the site drainage areas after treatment for suspended solids and pH in Water Management Zones (WMZs). It is currently permitted at a maximum flow rate of 1800 l/s via Outlet 1.

2.2.2 Activity I

The current version of Activity I contains treated trade effluent from cold commissioning activities. It is composed of water containing hydrazine, ammonia, ethanolamine, trisodium phosphate as well as effluent produced by the site's demineralised water plant. The demineralised water plant effluent (also known as demin reject water) will contain some metals due to the concentrating effects of the plant on substances naturally occurring in potable water as well as plant maintenance chemicals (biocides) and other treatment chemicals; this more detailed composition is currently being assessed by then Environment Agency as part of Variation 12. This discharge is currently permitted to be discharged via Outlet 12 at a flow rate of 70 l/s and a maximum daily discharge of 1,500m^3.

2.3 Effluent Development

2.3.1 Activity A

Water from the fire hydrant system which contains ammonia and ethanolamine will be released during the period testing of the hydrants. Operational experience at other power stations has indicated that it is not practical to contain this water. This will end up in the WMZs via the surface water management system and will be discharged via Outlet 1 as part of Activity A. Therefore, the addition of fire hydrant water from this testing to the Activity A description is requested. There is no increase in flow rate requested. It is expected that the hydrant system will be tested no more than monthly, due to costs, capacity and schedule constraints.

2.3.2 Activity I

The revised version of this Activity will contain cold commissioning effluents that require treatment though the Commissioning Effluent Treatment Plant (CETP) only. Thus, effluent containing ammonia and/or hydrazine will be treated and during treatment small amounts of copper and free chlorine may be

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introduced into the effluent. It is processed in the CETP and will continue to be discharged via Outlet 12 at a flow rate of 17.36 l/s, with a maximum daily discharge of 1,500m^3.

2.3.3 Activity J

The newly proposed Activity J will comprise the low-risk effluent from Cold Commissioning (containing ETA and trisodium phosphate) and the demineralisation plant effluent (containing copper, zinc, free chlorine and plant maintenance chemicals (biocides). This demineralisation plant effluent will be processed in the neutralisation pit to ensure it is between pH 6-9. The combined effluents under Activity J will be discharged via outlet 12 without any further treatment.

A daily discharge limit of 1,500m^3 with a flow rate of 17.36 l/s is proposed for **each of** the environmentally insignificant cold commissioning effluent (Activity J(i)) and demineralisation plant reject water (Activity J(ii). This will be discharged via Outlet 12. Note that this is in addition to the currently permitted 1,500m^3/day under Activity I.

3 ENVIRONMENTAL ASSESSMENT

3.1 Methodology

As this permit request includes discharging potentially hazardous chemicals, a surface water pollution risk assessment for estuaries and coastal waters was conducted in line with the Environment Agency's guidance (Environment Agency, 2022). Screening was carried out which involved identifying pollutants which will be discharged, gathering data on the pollutants such as the maximum estimated concentration of each chemical in the discharge, and then using this to carry out the screening tests.

These tests have five stages which are carried out in order;

- Test 1: Check if the discharge concentration is above 100% of the Environmental Quality Standard (EQS) or Predicted No Effect Concentration (PNEC) for each substance. If yes, Test 2 was carried out.
- Test 2: Check if you are discharging to the low water channel (if the water does not flow across the estuary bed at any stage of the tide) in the upper parts of an estuary where the water is mainly fresh. This does not apply in this scenario, therefore all substances which failed Test 1 moved on to Test 3.
- Test 3: Check if the discharge is emitted into a location with restricted dilution or dispersion. This is not the case for discharges from HPC outlet 12 and Activity I. Therefore, the assessment moved onto Test 4.

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- Test 4: Assess if the discharge location is less than 50m offshore from the seabed, or the seabed at discharge is less than 1m below chart datum. This does not apply in this scenario, so Test 5 was carried out for all substances which failed Test 1.
- Test 5: The Effective Volume Flux (EVF) is calculated and compared to a maximum allowable EVF of 3 m3/s. The EVF for each substance required to conduct Test 5 was calculated as set out in Table 1.

Table 1 Test 5 process for H1 Assessment

Step 1	Multiply the effluent discharge rate (in cubic meters by second) by the maximum discharge concentration of the chemical and element (in micrograms per litre).
Step 2	Subtract the average background concentration (assumed to be zero for most substances without sufficient data available) of the discharge location from the EQS/PNEC.
Step 3	Divide the result of step 1 by the result of step 2.

It is important to note that if the calculated EVF was below 3, the substance passed Test 5, and no further assessment is required.

3.2 Re-Assessment: Activity I

Whilst the concentrations of chemicals in the effluent produced by Activity I remain unchanged, a re-assessment (Table 2) has been carried out due to the change to a continuous discharge from a pulsed discharge.

Background water quality has been taken from previously agreed reports (Cefas, 2024)

- Copper: 3.95 (µg/L)
- Ammonia: 4.6 (µg/L)
- Hydrazine: 0.00015 (µg/L)

It has been assumed that the background value for free chlorine is zero.

EQS values were taken from the Water Framework Directive Directions for England & Wales (2015).

The Effective Volume Flux (EVF) was calculated as set out in Environment Agency guidance as follows:

$$EVF = \frac{Q.C_d}{C_s - C_b}$$

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Where:

Q = discharge rate in m^3/s

C_d = discharge concentration in µg/l

C_S = environmental standard (EQS/PNEC) in µg/l

C_b = background concentration in µg/l

Table 2 Copper, Ammonia, Hydrazine and Chlorine analysis summary

Element	CAS No.	Chronic EQS/ PNEC (µg/L)	Max. discharge conc. (µg/L)	Test 1	Test 2	Test 3	Test 4	Test 5 (EVF)
Copper	7440-50-8	4.76	102	Fail	N/A	N/A	N/A	Pass- 2.19
Total Ammonia	7664-41-7	1,100	271,200	Fail	N/A	N/A	N/A	Fail- 4.82
Un-ionized ammonia**	7664-41-7	21	41,947	Fail	N/A	N/A	N/A	Fail- 35.01
Hydrazine	302-01-2	0.0004 (ECHA)	15	Fail	N/A	N/A	N/A	Fail- 1041.66
Free Chlorine	7782-50-5	10*	5	Pass	N/A	N/A	N/A	N/A

* The EQS value for Chlorine was taken from the Water Framework Directive (Standards and Classification) Direction (England and Wales) 2015 and refers to Total Residual Oxidant (TRO)
** Total Ammonia converted to un-ionised ammonia assuming commissioning wastewater pH of 9.0 and mean temperature of 12.5°C

3.2.1 Justifications

Free Chlorine:

Referring to Table 2, Free Chlorine is predicted to be present in concentrations below its statutory EQS, and so no further testing was carried out as this is deemed environmentally insignificant.

Copper:

Copper passed Test 5 with an EVF of 2.19. Therefore, no modelling is required as no significant environmental impact is anticipated at the proposed discharge rate for Activity I, with a maximum concentration for copper of 102 µg/l.

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Ammonia:

Both Total and Un-ionised Ammonia failed Test 5 with an EVF of 4.82 and 150.35 respectively. However, General Estuarine Transport Model (GETM) modelling was carried out by Cefas which shows that there will be no exceedance at the bed or surface when discharging at these concentrations and proposed flow rates (Section 2.4 Cefas, 2024). These results are summarised in Table 3 and Table 4.

Table 3 Area of exceedance for total ammonia with a constant discharge (Cefas, 2024)

Scenario	Area > standard Bed	Area > standard Surface
Mean total ammonia - 17.36 L/s constant discharge at 271.26 mg/L	No exceedance	No exceedance
95th percentile total ammonia - 17.36 L/s constant discharge at 271.26 mg/L	No exceedance	No exceedance

Table 4 Area of exceedance for un-ionised ammonia with a constant discharge (Cefas, 2024)

Scenario	Area > 21 µg/L Bed	Area > 21 µg/L Surface
Mean un-ionised ammonia - 17.36 L/s constant discharge at 271.26 mg/L	No exceedance	No exceedance
95th percentile un-ionised ammonia - 17.36 L/s constant discharge at 271.26 mg/L	No exceedance	No exceedance

Previous modelling assessed the environmental impact of a pulsed discharge, but this has now been superseded as the discharge is changing to a continuous flow. Comparison of the two discharge types and the modelled exceedance at the bed and surface for both total and un-ionised ammonia is detailed in Table 5 and Table 6.

Table 5 Area of exceedance by discharge type for total Ammonia (Cefas, 2024)

Pulsed discharge (previous assessment)	Continuous discharge (current assessment)		Pulsed discharge (previous assessment)
	81 mg/L at 76.7 L/s (ha)	**271.26 mg/L at 17.36 L/s (ha)**	**Construction (38 l/s) + Commissioning (70 l/s) pulse (ha)**
Mean surface (standard 1.1 mg/L)	No exceedance	No exceedance	0.04
Mean bed (standard 1.1 mg/L)	No exceedance	No exceedance	No exceedance
95th percentile surface (MAC 8 mg/L)	No exceedance	No exceedance	No exceedance
95th percentile bed (MAC 8 mg/L)	No exceedance	No exceedance	No exceedance

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Table 6 Area of exceedance by discharge type for un-ionised ammonia (Cefas, 2024)

Scenario	Continuous discharge (current assessment)		Pulsed discharge (previous assessment)
	81 mg/L at 76.7 L/s (ha)	271.26 mg/L at 17.36 L/s (ha)	Construction (38 l/s) + Commissioning (70 l/s) pulse (ha)
Mean surface (EQS 21 µg/L)	No exceedance	No exceedance	No exceedance
Mean bed (EQS 21 µg/L)	No exceedance	No exceedance	No exceedance
95th percentile surface (EQS 21 µg/L)	No exceedance	No exceedance	0.20
95th percentile bed (EQS 21 µg/L)	No exceedance	No exceedance	No exceedance

The two biological receptors that hydrazine and ammonia are being assessed against in the Cefas report are *Corallina spp*. and *Sabellaria spp*. This report investigated the potential exposure of these species to hydrazine and ammonia with respect to their respective Predicted no-effect concentrations (PNEC) and Environmental Quality Standard (EQS). To be precautionary, maximum instantaneous concentrations were also investigated using time series at each station (A-G). Further reference to these stations can be found in the full report (Cefas, 2024).

At the locations of the *Corallina* and *Sabellaria* stations, results of the instantaneous concentrations show an improvement with reduced concentrations for the continuous discharge versus the pulsed discharge. At the *Corallina* stations, the EQS of 21 µg/l was not previously exceeded, however, the peak concentrations reduced from 8.5 µg/L with a pulsed discharge down to <3.7 µg/L for both continuous discharge scenarios. Similarly, for the *Sabellaria* stations, the EQS of 21 µg/L was not previously exceeded, however, the peak concentrations reduced from 10.5 µg/L with a pulsed discharge down to <3.8 µg/L for both continuous discharge scenarios. Therefore, it can be concluded that this discharge will not have a significant environmental impact.

Hydrazine

Hydrazine failed Test 5 with an EVF of 4.35. However, as with ammonia, modelling has shown that changing to a continuous discharge improved results when compared to the currently permitted pulsed discharge at the same concentration (Cefas, 2024).

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For both scenarios, neither the chronic nor acute PNEC are exceeded at the seabed. At the surface, the area of exceedance of the chronic PNEC has reduced by 1.03 ha, but the acute PNEC has increased by approximately 1.17 ha (See Table 7). This is not unexpected given the increased length of time of the discharge of a continuous discharge versus a pulsed discharge. Neither the pulsed discharge nor the continuous discharge exceeded the Canadian Standard of 200 ng/L as a 95th percentile at either the surface or bed. However, as a maximum (which represents a single hour in the 30-day simulation) the area of exceedance of 200 ng/L is reduced from 1.86 ha to 0.99 ha for the continuous discharge and is restricted to the area of immediate release.

Table 7 Comparison of areas of exceedance for hydrazine for a 15 µg/L continuous and pulsed discharge. (Cefas, 2024)

Scenario	ng/L	15 µg/L continuous surface (ha)	15 µg/L continuous bed (ha)	15 µg/L pulse surface (ha)	15 µg/L pulse bed (ha)
Chronic PNEC	0.4	14.86	0.00	15.89	0.00
Acute PNEC	4	6.64	0.00	5.47	0.00
Canadian Standard	200	0.00 (95th)	0.00 (95th)	0.00 (95th)	0.00 (95th)
Canadian Standard	200	0.99 (max)	0.00 (max)	1.86 (max)	0.00 (max)

At the locations of the *Corallina* and *Sabellaria* stations, results of the instantaneous concentrations show an improvement with reduced concentrations for the continuous discharge versus the pulsed discharge. At the *Corallina* stations, whilst the acute PNEC was not exceeded for either scenario, the peak concentrations for a pulsed discharge reached 3.7 ng/L, with a continuous discharge the concentrations do not exceed 1 ng/L for any station. For the *Sabellaria* stations, previously instantaneous concentrations with a pulsed discharge, exceeded the acute PNEC for 1 – 2 hours at times, with peak concentrations reaching 18 ng/L. However, with a continuous discharge, the acute PNEC is not exceeded at any point and the peak concentrations reach 1.6 ng/L.

The report presents modelling figures of hydrazine concentrations at each *Corallina* and *Sabellaria* station with both scenarios of constant release and pulsed release of discharges. As such, it can be concluded that the previous modelling of a pulsed discharge is more precautionary compared to results of the continuous discharge.

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3.3 Assessment: Activity J(i)

Activity J(i) will allow the discharge of the environmentally insignificant effluents previously considered as part of Activity I. The relevant effluent previously considered part of Activity I will contain ethanolamine (ETA) and trisodium phosphate, which were previously screened out during the determination of Variation 10 (see Cefas, 2021, Section 4.10) and so do not need further assessment in this variation.

3.4 Assessment: Activity J(ii)

3.4.1 H1 Assessment: Copper, Zinc and Free Chlorine

Copper, Zinc and Free Chlorine concentrations for both effluent streams were compared to their EQS, as seen in Table 8 below:

Table 8 Summary of Copper, Zinc and Chlorine concentrations in Activity J effluent stream

Parameter	Copper (µg/l)	Zinc (µg/l)	Free Chlorine
Demin Reject Water	102	140	1200
EQS	4.76	6.8	10

The concentrations of Copper, Zinc and Free Chlorine were above their relevant EQS in the demin reject water, and therefore Test 5 was carried out, as seen in Table 9.

Table 9 Test 5 for Copper, Zinc, and Chlorine in the demin reject water

Parameter	Copper	Zinc	Free Chlorine
Water Depth (m)	3	3	3
Flow rate (m3)	0.0174	0.0174	0.0174
Release conc. (µg/l)	102	140	1200
Discharge vol.*Conc (A)	1.77	2.43	20.83
Background conc. (µg/l)	3.95	3.035	0
EQS	4.76	6.8	10
EQS - Background conc. (B)	0.81	3.765	10
EVF (A/B)	2.19	0.65	2.08
<3?	**Yes**	**Yes**	**Yes**

Copper, Zinc and Free Chlorine from the demineralisation plant reject water all passed Test 5 with an EVF of less than 3. Therefore, this effluent stream required no further evaluation. Raw data is presented in Appendix B.

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3.4.2 H1 Assessment: Demineralised Water Plant Maintenance Chemicals

The chemicals required to maintain the Demineralised Water Plant have been, after allowing for the dilution and mixing inherent in their use, been assessed against EQSs and PNECs as appropriate. Where no EQS is set, PNECs have been derived from publicly available sources or taken from Environment Agency advice as summarised in Table 10, a detailed list of these can be found in Appendix C2.

It should be noted that, although a biocide (DBNPA) will be utilised within the plant, this will not present in the discharge.

By design, it is not possible for DBNPA (or any associated degradation products) to exist beyond the first pass RO and thus will not be present in the demineralised water. This is a core function of the RO membranes; to retain larger molecules within the waste concentrate. Similarly, any reactants from DBNPA (treatment of biofouling or inactivation) will be retained on the concentrate side of the membranes.

DBNPA is deactivated and broken down by sodium bisulfite ($NaHSO_3$) (EPRI, 2010) to simple products with low toxicity. Sodium bisulfite is already included within the operation of the plant, primarily to remove free chlorine from the potable water supplied to the plant. This is because free chlorine can damage the membranes. Sodium bisulfite will be added at such a rate as to ensure there is sufficient present to also inactivate the DBNPA. The thermodynamics of the reaction are highly favourable under a wide range of conditions and is expected to go to completion (EPRI, 2010; Atkins, 2018). The reaction kinetics are also favourable, and it is expected that the reaction will be completed within a few minutes in site conditions (EPRI, 2010). Therefore, all DBNPA will be degraded before the concentrate reaches the neutralisation pit. The treatment with sodium bisulfite (Veolia, 2022) will breakdown the DBNPA to various simple ions including sulphate, sulphite, bromide, sodium and ammonium (EPRI, 2010; Hydranautics, 2006). Therefore, no potentially harmful degradation products will be released.

Sodium bisulfite ($NaHSO_3$) is a reducing agent, which removes residual oxidants and other oxidising substances in the raw water supply. It works alongside DBNPA to selectively inactivate different types of bacteria. As detailed in the variation application, sodium bisulfite has a relatively high PNEC and is also readily degraded in the presence of oxidants (including dissolved oxygen present in water) and therefore, presents no significant risk to the environment.

Measures to ensure that the dosing rates of both DBNPA and sodium bisulfite are controlled to ensure that there is always sufficient (but not excessive) sodium bisulfite and will be included in the detailed operating documents for the demineralised water plant. It should be noted that the assessment of sodium bisulfite presented below uses the concentrations of the reagent added i.e. assumes that none of the bisulfite will be used up reactions and is therefore very conservative. Dosing rates will be optimised during operations to minimise chemical use.

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Table 10 Summary of H1 assessment for plant maintenance chemicals and CIP products used in the demineralisation plant

Product	Component	CAS No.	AA EQS/PNEC (µg/l)	MAC EQS	Max discharge conc. (µg/L)	Test 1	Test 2	Test 3	Test 4	Test 5 (m^3/s)
Antiscalant	ATMP acid	6419-19-8	40 (ECHA, 2024a)		218.19	Fail	N/A	N/A	N/A	Pass 0.095
	HDTMPA Potassium Salt	38820-59-6	100 (ECHA, 2024b)		87.27	Pass	N/A	N/A	N/A	N/A
	Potassium Hydroxide	1310-58-3	Screened out[2]		87.27	Pass				
Biocide for reverse osmosis and prevention of biofouling	2,2-dibromo-3-nitrilopropionamide (DBNPA)	0222-01-2	0.6 (Environment Agency advice)	70,000 (Environment Agency advice)	0	Pass	N/A	N/A	N/A	N/A

[2] Ionic substances where both ions are present in see water at high concentrations have not been numerically assessed. Any potential pH effects will be addressed through treatment and compliance with existing pH permit limits.

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Product	Component	CAS No.	AA EQS/PNEC (µg/l)	MAC EQS	Max discharge conc. (µg/L)	Test 1	Test 2	Test 3	Test 4	Test 5 (m^3/s)
Bisulfite	Sodium hydrogen sulfite (sodium bisulfite)	7631-90-5	84 (Environment Agency advice)		2,629.08	Fail	N/A	N/A	N/A	Pass 0.54
Basic cleaning agent	Tetrasodium ethylene diamine tetraacetate	64-02-8	220 Environment Agency advice)		3,001.05	Fail	N/A	N/A	N/A	Pass 0.24
	Sodium Hydroxide	1310-73-2	Screened out[2]		2,000.70	Pass				
	Sodium Ethylhexyl Sulfate	126-92-1	13.57 (ECHA, 2024f)		600.21	Fail	N/A	N/A	N/A	Pass 0.77
Acid cleaning agent	Citric Acid	77-92-9	44 (Carl Roth, 2024)		3,029.04	Fail	N/A	N/A	N/A	Pass-1.46
	Sulfamic Acid	5329-14-6	180 (ECHA, 2024g)		2,019.36	Fail	N/A	N/A	N/A	Pass 0.058
	PO-EO Block Polymer	9003-11-6	N/A		1,009.68					
Sulfuric Acid 96%	Sulfuric Acid (Discharged as Sulfate)	7664-93-9	Screened out[2]		4248.59	Pass				
	Ammoniacal Nitrogen	1336-21-6	21[3] (Water Framework Directive, 2015)		0.021	Pass	N/A	N/A	N/A	N/A
	Iron	7439-89-6	1000 (Water Framework Directive, 2015)		0.17	Pass	N/A	N/A	N/A	N/A
	Antimony	7440-36-0	11.3 (ECHA, 2024h)		0.0043	Pass	N/A	N/A	N/A	N/A

[3] EQS for un-ionised ammonia used for screening purposes as a conservative approach.

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Product	Component	CAS No.	AA EQS/PNEC (µg/l)	MAC EQS	Max discharge conc. (µg/L)	Test 1	Test 2	Test 3	Test 4	Test 5 (m^3/s)
	Arsenic	7440-38-2	25 (Water Framework Directive, 2015)		0.0043	Pass	N/A	N/A	N/A	N/A
	Cadmium	7440-43-9	0.2 (Water Framework Directive, 2015)		0.00021	Pass	N/A	N/A	N/A	N/A
	Lead	7439-92-1	1.3 (Water Framework Directive, 2015)	14 (Water Framework Directive, 2015)	0.021	Pass	N/A	N/A	N/A	N/A
	Mercury	7439-97-6		0.07 (Water Framework Directive, 2015)	0.003	Pass	N/A	N/A	N/A	N/A
	Selenium	7782-49-2	0.1 (Environment Agency advice)		0.021	Pass	N/A	N/A	N/A	N/A
Caustic Soda	Sodium Hydroxide	1310-73-2	Screened out		5,887.61	Pass				
	Sodium Carbonate	497-19-8	Screened out		11.54	Pass				
	Sodium Chloride	7647-14-5	Screened out		1.15	Pass				
	Sodium Sulfate	7757-82-6	1109 (ECHA, 2024j)		1.15	Pass	N/A	N/A	N/A	N/A
	Sodium Chlorate	7775-09-9	5.0 (Environment Agency advice)		0.69	Pass	N/A	N/A	N/A	N/A
	Iron	7439-89-6	1,000 (Water Framework Directive, 2015)		0.058	Pass	N/A	N/A	N/A	N/A
	Mercury	7439-97-6		0.07 (Water Framework Directive, 2015)	0.00058	Pass	N/A	N/A	N/A	N/A
	Nickel	7440-02-0	8.6 (ECHA, 2024l)	34 (Water Framework Directive, 2015)	0.012	Pass	N/A	N/A	N/A	N/A

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Product	Component	CAS No.	AA EQS/PNEC (µg/l)	MAC EQS	Max discharge conc. (µg/L)	Test 1	Test 2	Test 3	Test 4	Test 5 (m^3/s)
	Cadmium	7440-43-9	0.2 (Water Framework Directive, 2015)		0.0058	Pass	N/A	N/A	N/A	N/A
	Arsenic	7440-38-2	25 (Water Framework Directive, 2015)		0.012	Pass	N/A	N/A	N/A	N/A
	Chromium	7440-47-3	0.6 (ECHA, 2024m)	32 (Water Framework Directive, 2015)	0.0058	Pass	N/A	N/A	N/A	N/A
	Lead	7439-92-1	1.3 (Water Framework Directive, 2015)	14 (Water Framework Directive, 2015)	0.0029	Pass	N/A	N/A	N/A	N/A
	Antimony	7440-36-0	11.3 (ECHA, 2024h)		0.028	Pass	N/A	N/A	N/A	N/A
	Selenium	7782-49-2	0.1 (Environment Agency advice)		0.028	Pass	N/A	N/A	N/A	N/A

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All products to be used within the demineralised water plant which were analysed to be at concentrations above the EQS passed Test 5 when re-assessed at the lower flow rate associated with a continual discharge. This is in contrast to the results of the assessment carried out for Variation 12 of the permit, in which two substances (Citric Acid and Sodium Ethylexyl Sulfate) failed Test 5. Passing Test 5 indicates that they are below the required Effective Volume Flux (EVF) and would likely have no impact on the marine (saltwater) environment when discharged (this is based on discharge into a marine estuary environment, Bristol Channel). This shows that discharging continually has a lesser environmental impact compared to pulsed discharges.

Substances with no PNEC:

Some acids and alkalis such as potassium hydroxide, sodium hydroxide and sulfuric acid do not have enough data available to derive a PNEC value. However, environmental effects from these substances are due to corrosivity due to the pH values only rather than any innate toxic properties. All effluents will be between pH 6-9 when discharged and therefore this impact is neutralised, and the environmental impact will be minimal.

PNECs have been taken from the European Chemicals Agency where available. Where PNECs were not available from that source, an attempt was made to derive one using data as shown in Table 11 below. This ecotoxicity data was used in line with ECHA guidelines on deriving a PNEC (ECHA, 2008). However, as seen in Table 11, insufficient data was available for the PO-EO Block Polymer substance, and no PNEC could be derived.

Table 11 Ecotoxicity data for substances without registered PNEC

Product	Substance	Fish	Invertebrates	Algae	Assessment Factor	PNEC (µg/l)	Source
Acid cleaning agent	PO-EO Block Polymer	>120 mg/l, (*Oncorhynchus mykiss*) LC50	>100 mg/l, (*Daphnia magna*), EC50	No data available	Insufficient data	N/A	(Sigma Aldrich, 2023)

3.5 Assessment: Activity A

The following parameters were used when assessing the Environmental Impact of the addition of Ammoniated firewater to Activity A of the permit:

Volume released: 10,000l

Ammoniacal nitrogen Concentration: 12 mg/l

ETA Concentration: 4 mg/l

This effluent will eventually end up in one of Water Management Zones (WMZ) 1, 2 or 3, where it will be diluted with at least 681,000 litres of water (the minimum volume stored

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WMZ3) before discharge. The assessment carried out assumed that all the effluent generated will end up in WMZ3 to assess the worst-case scenario, with a summary of the results shown in Table 12.

Table 12 Summary of ammonia and ETA concentrations in WMZ3

Parameter	Ammoniacal nitrogen concentration (µg/L)	ETA concentration (ug/l)
Effluent from hydrants	173.56	57.85
EQS/PNEC[1]	AA: 1,100 MAC: 8,000	160
Above/below EQS/PNEC?	Below	Below

[1]. PNEC value for ETA taken from Cefas (2021). Ammoniacal nitrogen EQS values from Environment Agency guidance.

3.5.1 Justifications

Ammoniacal nitrogen

As seen in Table 12, after dilution in the WMZ, Ammoniacal nitrogen is present in concentrations below its relevant EQS. Therefore, no further assessment is required for Ammoniacal nitrogen.

Ethanolamine (ETA)

Ethanolamine is present in concentrations below the agreed PNEC value and therefore no further assessment is required.

3.6 In-Combination Assessment

Through Variation 13 of the CWDA permit, the flow rates will change from 70 l/s to 17.36 l/s for each of Activity I, Activity J (I) and Activity J (II). Therefore, a re-assessment of the in-combination effects of Total Copper, Total Ammonia and Total Zinc has been conducted (Table 13) to confirm that the overall Effective Volume Flux (EVF) values of each chemical will be below the highest EVF value permitted as part of CWDA Permit and, in the case of ammoniacal nitrogen, the Construction Sewage Treatment System Permit. This value is 26.16 for Zinc, which was previously assessed for Activity E2. A simple mass balance approach has been applied assuming maximum flow rate and modelled concentrations in each effluent stream as used to support the authorisation on that activity.

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Table 13 In-combination assessment: Final mix Copper, Ammonia and Zinc concentrations

WDA permit ref.	Activity	Outlet	Flow rates (l/s)	Copper concentration (µg/l)	Zinc Concentration (µg/l)	Ammoniacal nitrogen Concentration (µg/l)
JP3122GM	E2	1	20	221	1642.15	4,700
JP3122GM	F	12	0.57	68	189	0
JP3122GM	H	12	30	221	1,642.15	4,700
JP3122GM	I	12	17.36	102	0	271,200
JP3122GM	J (i)	12	17.36	0.00915	0.012	0
JP3122GM	J (ii)	12	17.36	102	140	0
XP3321GD	Treated sewage effluent	12	13.31	0	0	80000
Final mix			115.96	126.17	729.87	51,810.63

As shown in Table 13, the Construction Sewage Treatment Plant (HAJ) effluent stream has been added to reflect the permitted maximum concentration of ammonia it will have present, as well as its flow rate, in order to determine the final mix for ammonia. This is reflected in the calculated in-combination EVF value for ammonia, as shown below in Table 14. The EVF has been calculated in accordance with the Environment Agency's guidance using the equation presented in Section 3.2.

Table 14 In-combination assessment: Copper, Ammonia and Zinc EVF values

Parameter	Total Copper	Total Zinc	Total Ammonia
Water depth (m)	3	3	3
Flow rate (m^3/s)	0.116	0.116	0.116
Release conc. (µg/l)	126.16	729.87	51,810.63
Discharge vol.*conc. (A)	14.63	84.64	6,008.13
Background conc. (µg/l)	3.95	3.035	124
EQS	4.76	6.8	1,100
EQS – Background conc. (B)	0.81	3.765	976
EVF (A/B)	18.06	22.48	6.16

The in-combination EVF values for Total Copper, Total Zinc and Total Ammonia in the final mix are shown above in Table 14.

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For Total Copper, the EVF value is 18.06. This value is lower than the highest permitted EVF value for Zinc, which is 26.16, and this provides the justification for why this chemical concentration is compliant with the CWDA permit and therefore suitable for discharge to the estuary. Zinc concentrations giving this EVF are permitted as activities E2 and H in the CWDA permit.

For Total Zinc, the EVF value is 22.48. This value is lower than the highest permitted EVF value and this provides the justification for why this chemical concentration is compliant with the CWDA permit and therefore suitable for discharge to the estuary.

For Total Ammonia, the EVF value is 6.16. This value is lower than the highest permitted EVF value and this provides the justification for why this chemical concentration is compliant with the CWDA permit and therefore suitable for discharge to the estuary.

3.7 Treatment Approach

All effluent referenced in Table 13 and Table 14 will be neutralised to ensure a pH of between 6-9 prior to its discharge. It is important to note that there are limited options for further treatment of the substances/metals in the effluent. Any potential treatment options would require the use of further resources and would likely generate wastes requiring off-site disposal.

Offsite disposal/treatment via tankers would also be grossly disproportionate to the environmental impact of the effluent being discharged into the environment; this is due to the quantity of effluent being produced, up to 4,500 m^3 per day, which would require an excessive amount of transportation with its corresponding detrimental effect on the wider environment.

The aqueous wastes from the maintenance of the demineralised water plant are routed to a sealed “neutralisation pit” for treatment to ensure that the pH of the discharge effluent is acceptable. This will be an automatic process utilising a pH probe to control the dosing of sulfuric acid and sodium hydroxide to lower and raise the pH as required. Dosing rates and the “set points” for acceptable concentrations will be confirmed during the commissioning of the plant but will be such as to provide confidence that effluent discharged from this process has a pH between 6 and 9 as required under the permit.

The commissioning effluent treatment plant uses a multistep process to achieve the requisite destruction of hydrazine and ammonia as well as the removal of suspended solids to meet the permit requirements. The operation of this plant, and the controls in place to provide environmental protection will be detailed in an Operating Techniques Report (OT13) for agreement by the Environment Agency. However, in summary the plant will have the following steps:

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- Flocculation (with ferric chloride) and dissolved air filtration to remove suspended solids
- Sand filtration
- Hydrazine destruction (oxidation using hydrogen peroxide and a copper catalyst)
- Ammonia destruction (oxidation using sodium hypochlorite)
- Filtration through granulated activate carbon (polishing and removal of excess hypochlorite)
- Ion exchange (to recover copper catalyst for reuse).
- Online monitoring, to include pH, total suspended solids and ammonia effluent pH will be corrected at various points through the process as required to optimise the reactions and then to ensure compliance with the permit pH limits.

Note that the dosing rate for ferric chloride will be controlled to ensure that the residual iron is below the EQS of 1 mg/l. Therefore, a detailed assessment has not been undertaken. Periodic verification testing will be undertaken as this will be detailed in OTR13.

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4 CONCLUSIONS

Updated modelling and re-assessment of existing activities when changing to a continuous flow in comparison to the previously permitted pulsed discharge has shown an improved environmental impact.

The analysis of the fire hydrant water using the Environment Agency's Risk Assessment Methodology has shown that there are no significant environmental impacts anticipated from the addition of this effluent into Activity A.

Therefore, given the evidence provided in this report, permission for the following variation is requested:

- The addition of Activity J to the permit, consisting of the discharge of less environmentally challenging effluents associated with cold commissioning activities. This activity will specifically include:
    - Wastewater effluent associated with the flushing and hydrotesting of systems with water not containing hydrazine or ammonia at a rate of up to 1,500 m^3/day (Activity J(i)).
    - Wastewater effluent (concentrated waste effluent) from the production of demineralised water at a rate of up to 1,500 m^3/day (Activity J (ii)).
- Change from a pulsed discharge to a continuous discharge for activities I and J.
- Permission to allow small quantities (up to 10m^3) of ammoniated firewater to enter the surface drainage network to allow for the testing of fire hydrants on site.

  The data used within this assessment has been verified by NNB HPC against publicly available sources such as the European Chemicals Agency (ECHA) and is considered representative.

  The assessment has demonstrated that there would be no likely significant effect on the conservation status of the protected areas and would not impact on the Water Framework Directive status of the receiving waters.

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APPENDIX A: PERMITTED ACTIVITIES, DISCHARGES AND WASTE STREAMS UNDER ACTIVITY I

(extracted from the Environment Agency's decision document)

Variation EPR/JP3122GM/V009 amends the permit to include an additional water discharge activity (WDA), Activity I for the discharge of trade effluent consisting of effluent from cold commissioning activities, including hydro-testing and demineralised water production. Descriptive and numerical limits have been included in the permit to regulate this activity. These include:

i. Maximum daily discharge volume – 1500 cubic metres per day

ii. Maximum rate of discharge – 70 litres per second

iii. Maximum suspended solids (measured after drying at 105°C) – 675 milligrams per litre and 264 milligrams per litre annual average.

iv. Maximum and minimum pH range – 6 to 9

v. No significant trace present so far as is reasonably practicable of visible oil or grease

vi. Maximum concentration of Hydrazine – 15 micrograms per litre

vii. Maximum concentration of Ammoniacal nitrogen (expressed as N) – 271 milligrams per litre

Variation EPR/JP3122GM/V010 amends the ammonia limits for activities E2 and H. This amendment is to reflect the updated water quality modelling provided with the application.

The modelling used the 95th percentile concentration of ammonium, converted to ammoniacal nitrogen from borehole sampling as the source input from both these activities. The result of this ammoniacal nitrogen modelling was then converted to unionised ammonia concentrations using a standard algorithm (which considers salinity, pH and temperature, which are the key parameters in the conversion). Therefore, a single ammoniacal nitrogen limit as follows is appropriate to regulate both ammoniacal nitrogen and un-ionised ammonia on both of these activities:

i. Maximum concentration of Ammoniacal nitrogen (expressed as N) – 9.5 milligrams per litre

The Environment Agency has also amended the title of Activity F to "Cementitious wash water" and adjusted the suspended solids limit on all activities discharged via Outlet 12. This replaces the standard (250 mg/l) limit with more site-specific limits which represent the background levels in the receiving environment:

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i. Maximum suspended solids (measured after drying at 105°C) – 675 milligrams per litre.

ii. Maximum annual average (12 month rolling period) - 264 milligrams per litre.

Several monitoring and reporting conditions have also been removed as the discharge scenarios that required this monitoring are no longer occurring on site. These include:

i. Monitoring and reporting the muck bay drainage volume separately, as all effluent volumes discharged under Activity H will now be monitored as a combined effluent and compliance measured against original Maximum daily discharge volume of 2592 m^3/day and maximum rate of discharge limit of 30 litres per second.

ii. Reporting the combined total daily volume of Activity E2 and Activity H as flow balancing between these two activities is no longer required on site, and has been removed as a potential operating technique from the OT10 -Construction Water Discharge Activity Permit: Dewatering Operating Techniques Report and the OT12 - Construction Water Discharge Activity Permit: Tunnelling Operating Techniques Report.

We consider in reaching that decision we have taken into account all relevant considerations and legal requirements and that the permit will ensure that the appropriate level of environmental protection is provided.

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APPENDIX B COPPER, ZINC AND CHLORINE DATA AND CALCULATIONS

Table B 1: Potable water samples and analysis

Date	Sampling site	Free chlorine	Copper	Zinc
		mg/l	mg/l	mg/l
15/02/2023	HPC Fire Hydrant 1	0.25	0.02	0.01
15/02/2023	HPC Fire Hydrant 2	0.22	0.01	0.01
15/02/2023	HPC Fire Hydrant 1	0.26	0.01	0.01
15/02/2023	HPC Fire Hydrant 3	0.3	0.01	0.01
15/02/2023	HPC Fire Hydrant 6	0.54	0.01	0.01
15/02/2023	HPC Fire Hydrant 9	0.26	0.01	0.01
20/02/2023	HPC K14 Demand.S	0.24	0.01	0.01
20/02/2023	HPC K14 Tidy.Cam	0.25	0.01	0.01
20/02/2023	HPC K14 Unites.Ye	0.25	0.01	0.01
20/02/2023	HPC K14 Soap.Stru	0.27	0.01	0.01
21/02/2023	HPC K14B Pre tens		0.01	0.01
03/03/2023	PM KBJV R2X		0.01	0.01
03/03/2023	KBJV 63mm Road 2		0.01	0.01
09/03/2023	HPC Toilet Block 8	0.15	0.01	0.01
09/03/2023	HPC Toilet Block 8	0.18	0.01	0.01
13/03/2023	HPC Inside Toilet B	0.06	0.01	0.01
24/03/2023	HPC FH 18 HAN	0.33	0.05	0.03
24/03/2023	HPC FH 37	0.3	0.07	0.03

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Date	Sampling site	Free chlorine	Copper	Zinc
24/03/2023	HPC FH 96	0.2	0.01	0.01
24/03/2023	HPC FH 45	0.37	0.07	0.04
24/03/2023	HPC FH 32	0.32	0.04	0.02
24/03/2023	HPC FH 11	0.3	0.01	0.01
27/03/2023	HPC NOA 63mm fe	0.35	0.01	0.01
27/03/2023	HPC HAN Parent M	0.33	0.01	0.01
31/03/2023	K8B DE-MIN LINE		0.01	0.01
31/03/2023	K19 KBJV Parent M		0.01	0.01
06/04/2023	HPC K19B FH77 -	0.33	0.01	0.01
11/04/2023	K8B DE-MIN LINE	0.06	0.01	0.01
11/04/2023	K19 PARENT MAI	0.35	0.01	0.01
13/04/2023	HPC Site HOM Bal	0.06	0.01	0.01
13/04/2023	HPC Site Hydrant N	0.33	0.01	0.01
13/04/2023	HPC Site Hydrant N	0.33	0.01	0.01
13/04/2023	HPC Site Hydrant N	0.08	0.01	0.01
13/04/2023	HPC Site Hydrant N	0.3	0.01	0.01
14/04/2023	K14B WCC Supply	0.36	0.01	0.01
14/04/2023	K14B WCC Welfar	0.35	0.01	0.01
09/05/2023	HPC FH84 K23B	0.13	0.01	0.01
09/05/2023	HPC Linxon NFM P	0.21	0.01	0.01
09/05/2023	HPC Linxon NFM 2	0.16	0.01	0.01
09/05/2023	HPC FH41 K14	0.22	0.01	0.01
09/05/2023	HPC FH31 HAN	0.06	0.01	0.01

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Date	Sampling site	Free chlorine	Copper	Zinc
09/05/2023	HPC FH10 EOA	0.26	0.01	0.01
09/05/2023	HPC FH2 K5 Behin	0.25	0.01	0.01
09/05/2023	HPC FH42 K6	0.06	0.01	0.01
12/05/2023	HPC W/O Bylor Of	0.24	0.01	0.01
12/05/2023	HPC W/O Bylor Of	0.27	0.01	0.01
17/05/2023 10:23	KBJV K28 LAB CANTEEN	0.06	0.01	0.04
17/05/2023 10:45	KBJV K28 LAB SINK	0.06	0.01	0.09
17/05/2023 11:01	KBJV K28 OUTSIDE SUPPLY	0.06	0.01	0.12
18/05/2023 09:30	HPC SITE F3.1 CANTEEN	0.25	0.01	0.02
18/05/2023 11:00	HPC WCC WELFARE CABIN	0.31	0.01	0.01
23/05/2023 10:30	HPC Bottle station 6 K118	0.27	0.01	0.01
23/05/2023 09:00	HPC T.C.R Feed K11J	0.23	0.01	0.01
23/05/2023 09:15	HPC T.C.R Parent K11J	0.23	0.01	0.01
25/05/2023 08:45	HPC Toilet block 2/k10 Parent	0.19	0.01	0.01
25/05/2023 08:50	HPC Toilet block 2/k10 Feed	0.19	0.01	0.01
25/05/2023 08:55	HPC Toilet block 2/k10 inside block	0.19	0.01	0.01
28/06/2023 08:45	K28 Lab Supply KBJV	0.13	0.01	0.01
29/06/2023 06:43	K19 Parent Mian KBJV - ///circling.gobblers.lectures	0.27	0.03	0.03
29/06/2023 07:05	K8B DE-MIN LINE KBJV - ///suffer.juggled.offhand	0.25	0.01	0.01
30/06/2023 09:30	HPC/KIIW/ Hydrant 24 Parent	0.06	0.01	0.01
30/06/2023 09:40	HPC/KIIW/ Hydrant 24	0.06	0.01	0.01
30/06/2023 10:00	HPC/KIIW/ Hydrant 11	0.1	0.01	0.01
07/07/2023 09:00	HPC K19A PM	0.13	0.01	0.01

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Date	Sampling site	Free chlorine	Copper	Zinc
07/07/2023 09:10	HPC K19A Cabin	0.13	0.01	0.01
13/07/2023 11:00	HPC FH11 Parent	0.08	0.02	0.01
13/07/2023 11:10	HPC FH11 No 1	0.06	0.01	0.01
13/07/2023 11:20	HPC Lay Flat Hose 2	0.06	0.01	0.05
13/07/2023 11:30	HPC Lay Flat Hose 3	0.06	0.01	0.04
13/07/2023 11:40	HPC Lay Flat Hose 4	0.06	0.01	0.04
14/07/2023 08:15	HPC U2 HDAB building Parent K8D W47B	0.13	0.01	0.01
14/07/2023 08:20	HPC U2 HDAB building K8D W47B	0.11	0.01	0.01
14/07/2023 09:00	HPC emergency shower K14b	0.06	0.01	0.01
17/07/2023 08:37	KBJV LAB WELFARE TAP	0.07	0.01	0.01
17/07/2023 08:10	HPC Parent Main Connection K28/K28B	0.06	0.01	0.01
17/07/2023 08:20	HPC Jacobs Kitchenette K28/K28B	0.06	0.01	0.01
19/07/2023 08:30	HPC FH 36 K28	0.06	0.01	0.01
19/07/2023 09:00	HPC FH 60 K11	0.06	0.01	0.01
19/07/2023 09:30	HPC FH 77 K10	0.14	0.01	0.01
19/07/2023 10:00	HPC FH 66 K11	0.1	0.01	0.01
19/07/2023 10:30	HPC FH 22 K11	0.1	0.02	0.01
19/07/2023 11:00	HPC FH 114 K19	0.15	0.01	0.01
01/08/2023 08:40	HPC Jacobs Toilet block internal	0.06	0.01	0.01
04/08/2023 08:00	HPC K5A Parent Main	0.1	0.01	0.01
04/08/2023 08:15	HPC K5A New Filling Point	0.11	0.01	0.01
08/08/2023 11:00	HPC, W45 Bylor, Toilet 9	0.13	0.01	0.01
08/08/2023 11:15	HPC, W45 Parent	0.12	0.01	0.01

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Date	Sampling site	Free chlorine	Copper	Zinc
10/08/2023 09:00	HPC K12 Parent	0.09	0.01	0.01
10/08/2023 09:15	HPC K12 Bilfinger	0.14	0.01	0.01
21/08/2023 07:45	HPC FH23 K12	0.06	0.01	0.01
21/08/2023 08:15	HPC FH18 K11J	0.11	0.01	0.01
21/08/2023 09:00	HPC FH2 K5C	0.08	0.03	0.02
21/08/2023 09:45	HPC FH3 K11B	0.06	0.01	0.01
21/08/2023 10:45	HPC FH85 K18A	0.06	0.19	0.09
21/08/2023 08:30	HPC FH 97 K4	0.12	0.01	0.01
22/08/2023 09:05	Decisions Workroom SPEEDS Parent main	0.08	0.01	0.01
22/08/2023 09:20	Hardback. Landlady. Large 25mm Service	0.11	0.01	0.01
25/08/2023 09:00	K15B Bylor North Toilet	0.13	0.01	0.01
29/08/2023 16:00	HPC W15B HS2 Parent - Jabs, Drill, Flickers	0.06	0.01	0.01
29/08/2023 16:20	HPC W15B HS2 Toilet Block - Skater, Crossword, Clay	0.06	0.01	0.01
	Potable Water Mean	0.17	0.014	0.015
	Potable water 95th percentile	0.35	0.031	0.04
	Effluent (mean)	0.58	0.048	0.051
	Effluent (95th percentile)	1.17	0.102	0.13

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APPENDIX C CHEMICALS FOR USE IN DEMINERALISATION PLANT DATA AND CALCULATIONS

Table C 1: Annual consumption of substance and percentage of total effluent

Substance	Average Annual Consumption (l)	% of total effluent
Antiscalant	145	0.0873
Biocide for CIP and biofouling	427	0.257
Bisulfite	1092	0.657
Basic Cleaning Agent	3324	2.001
Acid Cleaning Agent	3355	2.019
Caustic Soda	1918	1.154
Sulfuric Acid	713	0.429

Total effluent per annum = 166,142 litres

% of total effluent = (Average annual consumption/Total effluent per annum) x 100

µg/l in effluent = ((% of total effluent/100) x %mass) x 10000

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Table C 2: Substance chemical composition analysis for maximum discharge concentration

Substance	Component	CAS No.	%Mass (max)	µg/L (max)	%effluent (max)	µg/l in effluent (max)
Antiscalant	ATMP acid	6419-19-8	25	250,000	0.021819	218.19
	HDTMPA Potassium Salt	38820-59-6	10	100,000	0.008727	87.27
	Potassium Hydroxide	1310-58-3	10	100,000	0.008727	87.27
	Water	7732-18-5	79			
Biocide for CIP and biofouling	2,2-Dibromo-3-Nitrilopropionamide (DBNPA)	10222-01-2	DBNPA is fully degraded by sodium bisulfite such that no product will be discharged. Degradation under these conditions progresses to simple ions that do not pose an environmental hazard.			
Bisulfite	sodium hydrogen-sulphite	7631-90-5	40	400,000	0.262908	2629.08
	Water	7732-18-5	65			
Basic cleaning agent	Tetrasodium ethylene diamine tetraacetate	64-02-8	15	150,000	0.300105	3001.05
	Sodium Hydroxide	1310-73-2	10	100,000	0.200070	2000.70
	Sodium Ethylhexyl Sulfate	126-92-1	3	30,000	0.060021	600.21
	Water	7732-18-5	91			
Acid cleaning agent	Citric Acid	77-92-9	15	150,000	0.302904	3029.04
	Sulfamic Acid	5329-14-6	10	100,000	0.201936	2019.36
	PO-EO Block Polymer	9003-11-6	5	50,000	0.100968	1009.68
	Water	7732-18-5	91			
Sulfuric Acid	Sulfuric Acid (Discharged as sulfate)	7664-93-9	99	990,000	0.424859	4248.59
	Residue on ignition		0.05	500	0.000215	2.15
	Free Sulphur Dioxide	7446-09-5	0.01	100	4.3E-05	0.43

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Substance	Component	CAS No.	%Mass (max)	µg/L (max)	%effluent (max)	µg/l in effluent (max)
	Total Chloride (HCl)	7647-01-0	0.0025	25	1.1E-05	0.11
	Oxides of Nitrogen	7697-37-2	0.0015	15	6.4E-06	0.064
	Ammoniacal Nitrogen	1336-21-6	0.0005	5	2.2E-06	0.021
	Iron (Fe)	7439-89-6	0.004	40	1.7E-05	0.17
	Antimony (Sb)	7440-36-0	0.0001	1	4.3E-07	0.0043
	Arsenic (As)	7440-38-2	0.0001	1	4.3E-07	0.0043
	Cadmium (Cd)	7440-43-9	0.000005	0.05	2.2E-08	0.00021
	Lead (Pb)	7439-92-1	0.0005	5	2.2E-06	0.021
	Mercury (Hg)	7439-97-6	0.00007	0.7	3E-07	0.003
	Selenium (Se)	7782-49-2	0.0005	5	2.2E-06	0.021
Caustic Soda	Sodium Hydroxide	1310-73-2	51	510000	0.588761	5887.61
	Sodium Carbonate	497-19-8	0.1	1000	0.001154	11.54
	Sodium Chloride	7647-14-5	0.01	100	0.000115	1.15
	Sodium Sulfate	7757-82-6	0.01	100	0.000115	1.15
	Sodium Chlorate	7775-09-9	0.006	60	6.9E-05	0.69
	Iron	7439-89-6	0.0005	5	5.8E-06	0.058
	Mercury	7439-97-6	0.000005	0.05	5.8E-08	0.00058
	Nickel	7440-02-0	0.0001	1	1.2E-06	0.012
	Cadmium	7440-43-9	0.00005	0.5	5.8E-07	0.0058
	Arsenic	7440-38-2	0.0001	1	1.2E-06	0.012
	Chromium	7440-47-3	0.00005	0.5	5.8E-07	0.0058
	Lead	7439-92-1	0.000025	0.25	2.9E-07	0.0029
	Antimony	7440-36-0	0.00024	2.4	2.8E-06	0.028
	Selenium	7782-49-2	0.00024	2.4	2.8E-06	0.028

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Table C 3: Test 5 for substance with a maximum discharge concentration above their PNEC

Substance	ATMP Acid	sodium hydrogen-sulphite	Tetrasodium ethylene diamine tetraacetate	Sodium Ethylhexyl Sulfate	Citric Acid	Sulfamic Acid
Water Depth (m)	3	3	3	3	3	3
Discharge rate (m^3/s)	0.0174	0.0174	0.0174	0.0174	0.0174	0.0174
Release conc. (µg/L)	218.19	2629.08	3001.05	600.21	3,029	2019
Discharge rate x Release conc. (A)	3.79	45.64	52.10	10.42	52.58	30.05
Background conc.	0	0	0	0	0	0
EQS/PNEC	40	88	220	13.57	44	180
EQS - Background conc. (B)	40	88	220	13.57	44	180
EVF (A/B)	0.09	0.52	0.24	0.77	1.46	0.19
< 3?	YES	YES	YES	YES	YES	YES

A - APPROVED

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